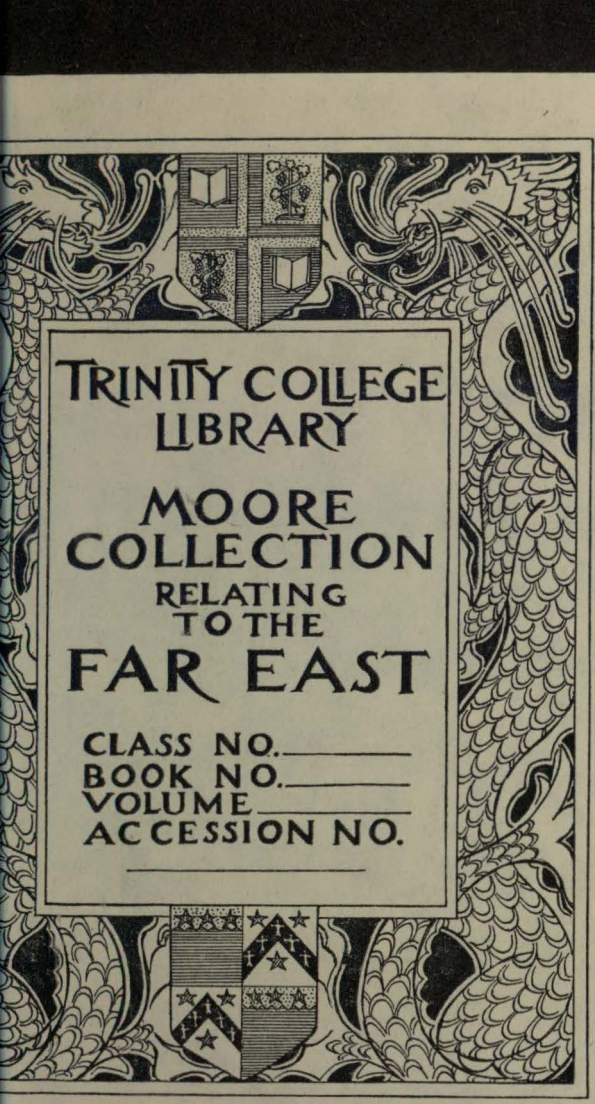

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THE PAPAYA

FOR

SOUTH CHINA

Bulletin No. 12

BY

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The Papaya for South China

G. W. GROFF, Canton Christian College

HOW THE MISSIONARY MAY USE THE INTRODUCTION OF A NEW FRUIT AS A POINT OF CONTACT WITH THE PEOPLE.

The papaya is a new fruit on the world's markets.

The Canton Christian College is interesting the Chinese of South China in its cultivation and is gaining a point of contact with the people.

Its methods reach gentry and peasants alike.

Boys' work is a medium for reaching the villagers close to the College.

Much of the expensive agricultural experimentation which has been done by the governments of other lands may be used to advantage by missionary agencies.

Agricultural effort of this kind brings the people to us instead of making us go to the people.

Bulletins on the papaya in Chinese and English are published by the Canton Christian College.

FEW in South China recognize the papaya as fruit worthy of cultivation. It is found here but is not grown commercially. It is grown in tropical and sub-tropical countries throughout the world but in all of these places it still remains to be developed for the world's markets. The work of fixing and breeding the type of papaya adapted to the conditions existing in South China should be undertaken at once. By so doing it may be possible to develop a profitable industry. The agricultural department of the Canton Christian College is now engaged in investigations along this line. It welcomes the co-operation of any who may be interested.

The papaya or melon tree, *Carica papaya*, is thought to be a native of Mexico or Central America but is now widely scattered throughout the tropics. It was doubtless taken into the Philippine Islands by the early Spanish settlers, and later introduced into China from these islands. The trees are now scattered throughout various sections of South China; but with few exceptions the fruit is of inferior size and quality. The type of fruit growing here ripens with great difficulty. It is not very highly prized by the Chinese. They usually pick it while it is green and either boil it as a vegetable or candy it. In medicine shops it is sold as a dried product under the name of "Chuen Mok Kwah." The Chinese mix this with rice-wine and use it as a tonic.

The papaya should be eaten as a fruit only when it is in a well ripened condition. A taste for the papaya is easily cultivated and its enthusiasts are many. As a fresh fruit it should find a more ready consumption by the Chinese people.

It should be cut lengthwise into slices and eaten the same as cantaloupe or water-melon. The juice of lime or lemon squeezed over the surface improves the flavor. When cut into blocks and mixed with pumelo or other citrus fruit, or apples, nuts, etc., it makes an excellent salad. It is not uncommon to spice it, green or ripe, using the same methods as for spicing water-melon and cantaloupe. A papaya stuffed with meat and bread and baked is excellent. The seeds of the papaya are said to be an efficient vermifuge.

Pepsin is a well-known, active digestive principle secured from animals. Papain is a closely related vegetable product and is found in great quantities in the fruit and sap of the papaya. The fruit, therefore, if eaten in sufficient quantities, gives assistance to the digestive organs of the body. This digestive property of the sap of the papaya is so great that if tough meat is wrapped in the leaves of the papaya for a few hours before cooking, the meat becomes tender and soft. A little raw meat placed in the juice of the papaya will entirely disappear.

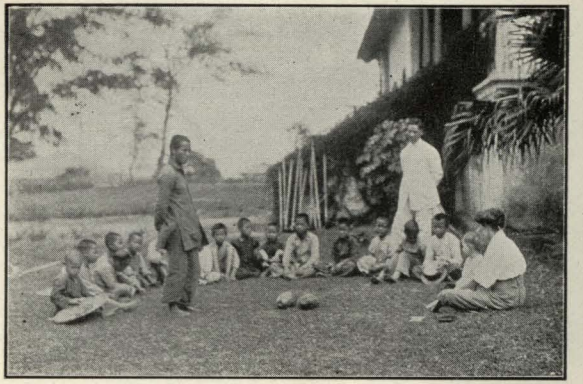
The Hawaii Experiment Station has recently reported that papain, the dried juice of the papaya, can be produced at a profit of more than $5.00 gold per kilo, equivalent to about $4.50 Mexican per pound. The fact that this papain of commerce is considered superior in digestive virtues to the pepsin obtained from animals should create a ready market for its sale. This opportunity is attracting some interest among Philippine farmers ; it should also interest the farmers of South China.

The papaya fruit is the size and shape of melons. These are fortunately borne close to the trunk and not on branches where their great weight could not be carried. The tree is rarely branched but has large palm-shaped, tropical-like leaves. These are borne on foot-stalks often two feet in length ; they are deeply lobed and are often a foot and a half to two feet long. It is a beautiful tree, erect and stately.

The tree grows from a small insignificant seed. When the papaya is cut open the seeds are found clustered closely together. Each little seed is strangely encased in a jelly-like bag. In ripe papaya the seed often germinates before the papaya is opened. The little plants start quickly and in Kwangtung attain to a height of eight or ten feet the first year, if the ground in which they are planted is loose and fertile. Fruit will ripen the second year. In good ground the average



Village Farm School boys bring their friends and parents to the College on Christmas Day.



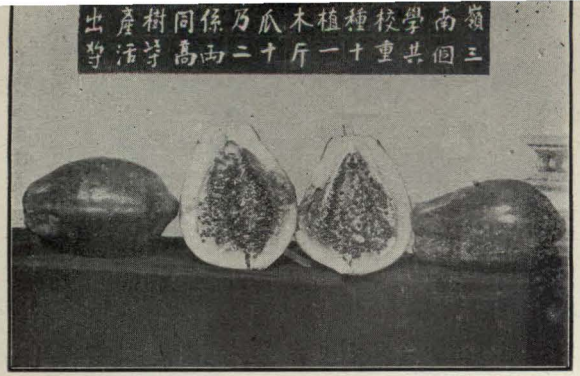
Village Farm School boys encircling "Ling Naam" papaya, preparatory to tasting.



Papaya and pineapple thrive on hillsides. "Ling Naam's" prize papaya tree.



Village Farm School boys holding two beautiful "Ling Naam" papaya of Honolulu type



Three select papaya grown at the Canton Christian College.



The family of a Canton doctor who believes in papaya and buffalo cow milk for children.



Ling Naam's two-year old papaya orchard and Canton Christian College Agricultural Students.



Comparing the Hawaiian type of papaya with the native type.

yield per tree is thirty to forty fruits of .75 to 1.5 kilos (one and one half to three pounds) each.

It should be remembered that the papaya is more of a tropical than sub-tropical fruit. For this reason in Kwangtung it should be given well-sheltered positions, away from the cold north winds of winter. The tree requires fertile, well-drained soil for its best development. High elevations, such as that found between grave land and rice fields, if the soil is sandy and well drained, are especially well adapted to the growth of the papaya.

The best fruit of the year ripens on the trees in October and November; some fruit is also secured in the spring of the year. The flavor of the fruit is greatly improved if they are allowed to ripen on the trees.

The most peculiar thing about the papaya tree is that unlike most other fruit trees there is a strong tendency to develop not only distinct staminate and pistillate flowers but even distinct male and female trees. This is especially true of the uncultivated or wild forms which are those commonly found in Kwangtung. The result is that an orchard of papaya trees grown from seed of unselected fruit will contain 50% or more of male or fruitless trees. This condition greatly decreases the growers' profit. There have been a number of experiments in grafting the papaya in the hope that this condition could be overcome. But it has recently been observed in Florida that the papaya degenerates very quickly when propagated by grafting.

The greatest hope for the future development of the papaya lies in the fact that this male and female characteristic of the tree is not at all fixed but that there exists at least five or six types of tree, varying from the distinct male and the distinct female trees to hermaphrodite types of various forms. The Hawaii Agricultural Experiment Station has grasped this fact and during recent years has set to work in selecting and breeding a very desirable hermaphrodite papaya with every promise of success.*

The Canton Christian College began its work on the papaya about eight years ago. The start was made with only one tree, the seed of which came from Honolulu. The fruit of this tree was so superior to anything grown in the vicinity

* The ideas regarding the breeding of the papaya advanced in this article are largely those of Mr. J. E. Higgins, Horticulturist, Hawaii Agricultural Experiment Station, Honolulu, T.H.

of Canton, especially in its ripening qualities and flavor, that later we imported a large quantity of seed from Hawaii. We also planted seed from our original Honolulu tree.

This has been the first year that we have had visible results of the work. We have on our campus to-day more than two hundred trees of various types and quality. We now propose to select and breed from these a strain of papaya adapted to the conditions in Kwangtung. We hope to co-operate with others who are interested in the introduction and improvement of the papaya and who may wish plants of our strain. In this way we hope in the years to come to secure for Kwangtung a better papaya than that found here at the present time.

The Chinese have always shown great interest in our efforts with the papaya. Students at first spurned the idea of growing papaya as a marketable fruit; to-day we cannot produce enough papaya for consumption on our own campus. Students will scarcely wait until the fruit ripens before they pick it, and bring it to the college garden office where they pay us 10 cents per catty (1⅓ lbs.) for it. This is twice the price of citrinous fruits, which they prize so highly.

Many of the Chinese visitors from the city are proud to carry back with them one or more "Ling Naam" papaya. Foreign residents of Canton insist upon having papaya with their weekly delivery of vegetables. Village Farm School boys are constantly on the alert for seeds to take back to their villages and they bring their friends and parents to see our trees.

All this vitally associates our institution with the problems and interests of the people and gives us the point of contact which we seek.

Methods of Propagation and Cultural Directions for South China.

One of the chief difficulties in connection with the propagation of the papaya in Kwangtung is to find a suitable season for starting the young plants. We must not forget that we are attempting to adapt a fruit which is naturally tropical to our sub-tropical conditions. The fact that the seed often germinates before the ripened fruit is opened and that it quickly loses its germinating power indicates that the seed should be quickly planted after the maturing of the fruit. As the best

fruit ripens in Kwangtung in late fall we experience the difficulty of starting the young plants in the coldest season of the year when it is almost impossible to work successfully without artificial heat. If the seeds from the fall crop can be started under the heat of a glass or cloth house during the winter months and set out into the ground in early summer much more satisfactory results can be obtained. Without this it is either necessary to save the seed of the fall crop in bottles or jars or use the seed of the spring crop. If the former method is followed sufficient seed should be saved to allow for a low percentage of germination. In late spring this seed should be thinly sown in a well-drained bed of good sandy loam rich in humus. As the rains are heavy at this time of the year it is well to have this bed covered with bamboo stripping or other device to prevent the heavy rains from injuring the young plants. If there is at hand a plant propagation shed this is the best place to start the young plants. When the plants are three to five inches high they should be set out into pots which should be placed in a protected position. When the plants are about a foot in height they should be set out into the open ground. The maximum distance for planting papaya is four meters (13 feet) each way. If the strain grown is not yet fixed in its hermaphrodite characteristic we must expect a large number of male or useless trees and the trees should be planted closer to allow for cutting down the male trees.

In choosing a suitable site for either a few papaya trees or for an orchard, the first consideration must be whether or not the grower will be able to maintain perfect drainage throughout the entire season of the year. It is folly to plant papaya trees on any ground so low that it is subject to floods. Nothing will kill a papaya tree quicker than for the roots of the tree to be covered by water, if only for a few days. In fact papaya trees cannot be grown successfully in any soil which holds the water for any length of time. Sandy elevations, especially those sloping to the south or well protected from the cold north winds, are adapted to the needs of the papaya.

As most of the soil in Kwangtung is very deficient in organic matter and therefore often difficult to air and drain properly, in planting papaya at the College we have found it advisable to dig a trench or a large hole, mix this excavated earth with any form of garbage or humus, refill the hole with this mixture, and then plant the trees in this loose earth several

inches above the surrounding ground. As the tree grows it is advisable to trench again farther out near the little roots of the tree and fertilize again. Great care must be taken in this operation not to tear up the young roots of the plant. An old pond site or any piece of ground recently filled in with loose earth is admirable for papaya trees. Gold position can often be found in close proximity to the home, where the tree will not only make a good appearance but prove a most interesting and useful member of the family. In orchard planting we are experimenting with the planting of pineapple between the rows of papaya. We believe this will prove successful.

Fourteen Ideals to be kept in mind in Selecting and Breeding the Papaya as advocated by Mr. J. E. Higgins of the Hawaii Agricultural Experiment Station.

1. Vigor of tree—Only the most vigorous individuals should be used as parent stocks.

2. Early and low fruit habits—The advantage of early and low-bearing trees is obvious. This character is transmissible.

3. Freedom from the branching habit.

4. Productivity but not excessive bearing—The fruits should be well spaced on the stem.

5. Hermaphroditism—The advantage of few males is obvious.

6. Suitable size of fruit—For table varieties one and a half to three catties is large enough.

7. Yield in papain—The average yield per tree of this drug can be greatly increased by careful breeding.

8. Uniformity of shape—The hermaphrodite tree usually bears a long form. Pistillate trees usually yield a rounded form. The breeder may best work for these two forms.

9. Uniformity in ripening—Some papayas will ripen and decay one portion of the fruit before the other portion begins to ripen. This defect should be eliminated by breeding.

10. Coloring before softening—Some fruits ripen with little color, while others acquire a beautiful golden yellow while still hard. The latter are more attractive on the table.

11. Color of flesh—Those of a pale whitish flesh must give place to those of yellow, pink, or red color.

12. Easily separable placenta—It should be possible to remove the seeds and placenta without marring the flesh of the fruit.

13. Flavor—This is without doubt the most important factor to be considered.

14. Keeping qualities—The ideal papaya should be a good keeper.

Directions for the Manufacture of Papain. Estimate of Profits to be Derived.

Dried papaya juice, the papain of commerce, is now considered superior to the pepsin obtained from animals. It is collected and manufactured with profit. When the fruits of the papaya are a fair size, but still green, cuts are made in the flesh. The juice flows readily from these cuts and is collected and dried at a temperature which must not be above 120 to 125 degrees Fahrenheit. The juice of the papaya is very corrosive and if metal receptacles are used the metal is acted upon by the juice and the result is a very inferior quality of product. The greatest care in the manufacture of papain is to tap the fruits at the proper time and to use care in the evaporation of the juice.

The Hawaii station estimates that if the trees are planted at a maximum distance of four meters apart, one hectar (12.5 *mow*) would contain 625 papaya trees, with a yield of $2,500 Mexican dollars worth of papain, extending over a period of two years.